Not to be cited without
permission of the authors[1]

Ne pas citer sans
autorisation des auteurs[1]

DFO Atlantic Fisheries
Research Document 95/8

MPO Pêches de l'Atlantique
Document de recherche 95/8

Update on Striped Bass Stock Status in Scotia-Fundy Region and Proposals for Stock Management

by

B.M. Jessop
Biological Sciences Branch
Department of Fisheries and Oceans
P.O. Box 550
Halifax, Nova Scotia
B3J 2S7

[1]This series documents the scientific basis for the evaluation of fisheries resources in Atlantic Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

Research documents are produced in the official language in which they are provided to the secretariat.

[1]La présente série documente les bases scientifiques des évaluations des ressources halieutiques sur la côte atlantique du Canada. Elle traite des problèmes courants selon les échéanciers dictés. Les documents qu'elle contient ne doivent pas être considérés comme des énoncés définitifs sur les sujets traités, mais plutôt comme des rapports d'étape sur les études en cours.

Les Documents de recherche sont publiés dans la langue officielle utilisée dans le manuscrit envoyé au secrétariat.

Abstract

Stocks of native-origin striped bass (Morone saxatilis) in the Bay of Fundy area of Scotia-Fundy Region are severely depressed in the Annapolis River, Nova Scotia, possibly extinct in the Saint John River, New Brunswick, and moderately abundant in the Shubenacadie/Stewiacke River, Nova Scotia. Fishing pressure by anglers and bycatch in commercial fisheries in conjunction with loss of spawning habitat in the Saint John River and poor water quality in the Annapolis River are believed responsible for the reduction in native stock abundance. An increased abundance of feeding migrant striped bass of U.S. origin in rivers of the Scotia-Fundy Region consequent to their increased abundance due to the success of the U.S. striped bass management and rehabilitation plan implemented during the 1980s, has obscured the extent of the decline in the Bay of Fundy area of native-origin striped bass stocks. Recent changes to the striped bass management plan have been made to reduce striped bass exploitation in Scotia-Fundy Region. Active stock rehabilitation via hatchery stocking may be required to restore native stocks in the Annapolis and Saint John rivers. A rehabilitation program must be initiated promptly and on a sufficient scale if native striped bass stocks are to be conserved and rebuilt where threatened in the Bay of Fundy area.

Résumé

Les stocks indigènes de bar rayé (Morone saxatilis) de la région de la baie de Fundy sont fortement appauvris dans la rivière Annapolis (Nouvelle-Écosse), sans doute disparus de la rivière Saint-Jean (Nouveau-Brunswick) et modérément abondants dans la rivière Shubenacadie-Stewiacke (Nouvelle-Écosse). La pression de pêche exercée par les pêcheurs sportifs et les prises accessoires des pêcheurs commerciaux, alliées à la disparition de frayères dans la Saint-Jean et à la piètre qualité des eaux de l'Annapolis, apparaissent comme les facteurs de l'appauvrissement des stocks indigènes. Une augmentation de l'abondance de bars rayés d'origine américaine en migration d'alimentation dans les rivières de la Région Scotia-Fundy a masqué l'étendue du déclin des stocks indigènes de la baie de Fundy. Ce phénomène s'explique par une plus grande abondance de ces poissons due à la réussite de leur gestion et d'un plan de redressement mis en oeuvre aux États-Unis au cours des années 1980. Des modifications ont récemment été apportées au plan de gestion du bar rayé afin d'en réduire l'exploitation dans la région de la baie de Fundy. Il pourra s'avérer nécessaire de procéder à un rétablissement actif des stocks indigènes des rivières Annapolis et Saint-Jean par ensemencement de sujets de pisciculture. Le maintien et le rétablissement de l'espèce dans les zones de la baie de Fundy où elle est menacée supposent qu'un tel programme, d'une envergure suffisante, soit mis en oeuvre rapidement.

Introduction

Since publication of "The status of striped bass in Scotia-Fundy Region" (Jessop 1990), concerns have increased by Department of Fisheries and Oceans (DFO) biologists, some anglers, and others associated with the fishery about the depressed and/or endangered status of striped bass (Morone saxatilis) stocks in, particularly, the Saint John River, New Brunswick and the Annapolis River, Nova Scotia. Recent research efforts have focused on determining the occurrence and extent of spawning by native stocks of striped bass in the Annapolis and Saint John rivers and the stock composition of angled and bycatch-caught fish in the Annapolis, Saint John, and Shubenacadie (Shubenacadie/Stewiacke, Nova Scotia) rivers. The results of these studies imply a serious threat to the viability and existence of native stocks of striped bass in the Saint John and Annapolis rivers that requires attention by fishery managers.

Saint John River

A DFO survey during early through late June of 1992 for spawning activity by striped bass at potential spawning sites, based on their hydrology and the reported presence of striped bass, in the Kennebecasis and Hammond tributaries of the Saint John River failed to collect any eggs in either tows or sets of 1 m diameter plankton nets. The conclusion was that spawning activity in these areas was minimal to nonexistent. A seine survey of various beach areas near potential spawning areas in upper Kennebecasis (5 sites) and known spawning areas in Belleisle bays (6 sites) during late August of 1992 failed to capture juvenile striped bass, although juveniles and adults of at least 10 other species were captured. Striped bass juveniles are known to frequent shallow-water, nearshore areas, as do the juveniles and adults of numerous other estuarine species (Setzler-Hamilton and Hall 1991).

In 1994, more extensive surveys of striped bass spawning and juvenile presence (sponsored by the Reversing Falls Striped Bass Anglers/N.B. Cooperation Agreement on Recreational Fisheries) were conducted between June and August. No striped bass spawning eggs were found during June at four sites (selected on the basis of literature reports of historic spawning activity or general site characteristics) distributed throughout the Saint John River estuary (main river downstream of Mactaquac Dam, Canaan River/upper Washademoak Lake, Belleisle Creek, and lower Kennebecasis/Hammond rivers) and it can be concluded that striped bass spawning activity in the lower Saint John River was minor or nonexistent. Spawning success was further assessed by surveys for juvenile striped bass conducted weekly between late July and late August at beach sites downstream of the egg survey sites. No juvenile striped bass were captured although other near-shore resident species typically found in association with juvenile striped bass, e.g., juvenile gaspereau, perch, shiners were captured in numbers ranging from a few to several hundreds. Again, the conclusion is that the success of spawning by striped bass in the Saint John River is poor-to-negligible and that this circumstance has continued for at least two, and likely more, years. The Reversing Falls Striped Bass Anglers were unsuccessful in their search for juvenile striped bass less than 30 cm long and 0.9 kg in weight. Striped bass of this size should be less than three years old and probably non-migratory; if found they would indicate successful spawning in the Saint John River two to three years previously.

The last positive report of juvenile (1 yr) striped bass in the lower Saint John River was in 1979 (M. J. Dadswell, DFO memorandum, 2 February 1982). In the mid-1970s, Dadswell (1976) concluded that the "local population is at a very low ebb and may be threatened with extinction...", and that the last successful year-class occurred in the late 1960s because 1-2 year old striped bass were abundant as late as 1969. Dadswell (1976) reported collecting over 1,800 striped bass eggs in Belleisle Creek during 1975. About 96% of these eggs had broken membranes and were thus unlikely to survive until hatching.

Determination, by mitochondrial DNA analysis, of the stock composition of adult striped bass captured during July and August of 1992 and 1993 at the Mactaquac Dam fishway (while on their summer feeding migration) or angled during 1993 by the Reversing Falls Striped Bass Anglers in the lower Saint John River indicated that about 75-80% of striped bass were classified as being of U.S. origin (primarily from the Hudson River, New York) and 20-25% were classified as of Shubenacadie River origin (Wirgin et al. in press). The genetic characteristics of native Saint John River striped bass are presently unknown but are expected to resemble those of Shubenacadie River fish

more than those of Hudson River fish.

The absence of, or minimal presence of, striped bass spawning activity and of juvenile fish in the Saint John River and of the high proportion of non-native striped bass adults is strong evidence that the stock of striped bass native to the Saint John River is presently near, or may already have become, extinct.

Annapolis River

Surveys of striped bass spawning activity and juvenile presence conducted in the Annapolis River since the mid-1970s are consistent with a pattern of declining spawning activity and failure of egg survival. In 1975, plankton net tows during June in the Bridgetown area caught small numbers of striped bass eggs. Seine surveys (mid-June to mid-August) of the estuary of the lower Annapolis River between just-upriver of Bridgetown and the Annapolis Royal causeway caught a few juvenile striped bass near Round Hill (Jessop 1976). In 1976 and 1977, large numbers (over 6,000 eggs in 1976) of striped bass eggs were caught in June upriver of Bridgetown (Williams et al. 1984). Spawning activity was also observed in 1976 and three larval striped bass were caught. No juvenile striped bass were collected during either year, despite extensive seine surveys between June and August throughout the Annapolis River estuary (Williams et al 1984; Daborn et al. 1979). In 1980, seine surveys of the Annapolis River estuary between early June and late September also failed to capture any juvenile striped bass (Jessop 1983).

Jessop (1990) notes that "Eggs spawned in the Annapolis River are viable and have a high hatching rate when held in water of suitable quality from sources other than the Annapolis River (Wiles 1979; Jessop 1980; Parker and Doe 1981; Jessop, unpublished data). About 42% of almost 68,000 striped bass eggs collected in 1979 from the Annapolis River were viable; 46% of 5,300 eggs were hatched experimentally (Parker and Doe 1981). Eggs obtained from the Annapolis River in 1981 were hatched and the larvae successfully reared to sizes of 60-80 mm with minimal mortality; almost 600 striped bass fingerlings were released into the Annapolis River in September of 1981 (Jessop 1990).

A spawning survey by DFO in June of 1992 failed to collect any striped bass eggs; a seine survey during August of sites between just-upriver of Bridgetown and several kilometres upriver of the Annapolis Royal causeway did not find any juvenile striped bass. In June of 1994, a spawning survey (Clean Annapolis River Foundation/Bear River First Nation) collected about 400 striped bass eggs over a period of about 10 days in early-to-mid June. Extensive seine surveys of the lower Annapolis River from June through September found no juvenile striped bass (Dr. G. Daborn, Acadia University, personal communication). The pattern over the last 23 years or so is one of declining striped bass spawning (evidenced by declining quantities of eggs taken in spawning surveys, in total and after adjustment for fishing effort) and a failure of eggs to hatch or larvae to survive (evidenced by an absence of juvenile striped bass in all years).

The age-structure of striped bass angled in the Annapolis River increased through the 1970s in a manner consistent with a lack of recruitment from native striped bass. An increasing proportion of medium-sized and aged fish appeared in the mid- 1980s and into the 1990s, which is consistent with increasing proportions of feeding migrants from other Bay of Fundy and U.S. rivers (Jessop 1980; Harris and Rulifson 1988). Twenty-five striped bass angled in the Annapolis River in 1994 were characterized during preliminary mtDNA examination to be of U.S. origin (I. Wirgin, personal communication). The situation in the Annapolis River seems similar to that in the Saint John River, where the strong resurgence of American striped bass stocks in the late 1980s and their present abundance in the 1990s has helped to mask the declining condition of native stocks of striped bass (Wirgin et al. In press).

Shubenacadie River

The stock of Shubenacadie River striped bass is also depressed, although not as severely as those of the Annapolis and Saint John rivers. Shubenacadie River striped bass are exploited as bycatch in the drift-net fishery for American shad and by angling. Reliable statistics on the historic trend in bycatch and angling are unavailable.

The estimated bycatch sold to a local fish buyer (Mr. R. Meadows, General Delivery, Stewiacke, B0N 2J0; pers. comm.) between 1989 and 1994 has averaged 188 fish (range 95-258). Bycatch striped bass have averaged about 4.2 kg in weight based on the pooled data from sampling in 1992 ($\underline{N}$ = 37, mean weight (kg) = 3.54, SD = 3.47) and 1993 ($\underline{N}$ = 59, mean weight (kg) = 4.58, SD = 3.35). Most adult striped bass collected in the Shubenacadie River were found to be of native origin but a small proportion (< 10%) were characterized as of U.S. (Hudson River) origin (Wirgin et al. In press).

Fishery Management

Acceptance that the stocks of striped bass native to the Annapolis and Saint John rivers are in danger of extinction, if not already extinct, requires immediate and firm action to fulfil the DFO mandate to maintain and, ultimately, to rebuild threatened stocks. The objectives for striped bass management outlined in the discussion document "A management strategy for striped bass in New Brunswick" (Fisheries and Oceans 1992) apply equally to Nova Scotia. Meaningful consultations with stakeholders are necessary to inform them of the status of each stock and to gain their input on and, ultimately, acceptance of and cooperation with fishery management actions. The options for management action will obviously vary with degree of acceptance of the desirability of maintaining native stocks and the fishery restrictions implied by such acceptance. If our concern is protection and natural rebuilding of the stock, then management actions will firmly restrict exploitation. If our concern is to accelerate, possibly ensure, stock restoration then appropriate culture and release programs will be needed. The success of protection and rehabilitation actions should be evaluated by suitably structured monitoring programs. If our concern is angling opportunity rather than protection of native stocks, then current restrictions on the fishery could be reduced to permit greater exploitation of migrant fish of U.S. origin. A mix of management actions may be most appropriate.

Problem Origins

Environmental problems may be the root cause of reduced striped bass recruitment in both the Annapolis and Saint John rivers. In the Annapolis River, the exact nature of the water quality problem that reduces striped bass egg and larval survival must be identified and corrected if the stock is to be saved. This will not be easy and may be impossible. In the Saint John River, reclaiming the spawning habitat lost when the Mactaquac Dam was built (Adams 1873; Jessop 1990) may also be impossible, although stock abundance may rebuild somewhat if other potential spawning sites downriver are utilized. Rebuilding the native stock of striped bass in the Shubenacadie River to a level closer to historic abundance and environmental carrying capacity should be possible with less severe restrictions to exploitation than necessary for the Annapolis and Saint John rivers and no recourse to stocking.

Management Options

Maintenance of a threatened stock in a mixed stock fishery requires that management actions protect the weakest stock. Once a stock has become severely depressed, severe restriction or elimination of angling and commercial exploitation is the most basic of protective actions. Recent changes in the angling regulations to reduce the daily bag limit to one fish and to impose a minimum size limit are useful protective measures (Fisheries and Oceans 1994) but may be inadequate on the Annapolis and Saint John rivers where a total ban on purposeful killing of striped bass is likely to be the only solution to preserve native stocks for the foreseeable future. Even the low mortality on native stocks resulting from catch-and-release may be intolerable. Serious consideration should be given to banning the possession of striped bass bycatch in commercial fisheries, particularly the shad fishery in the Shubenacadie River. Appropriate changes to the fishing season might also serve to reduce the incidence of bycatch.

The abundance of non-native, migratory fish will obscure the need for, and any success of, efforts to protect the endangered native stocks. Anglers will be unhappy at foregoing the retention of fish (undoubtedly mostly non-native) when they seem abundant. Some stakeholders might conclude that the marginal status and uncertain future outlook for Annapolis and Saint John river striped bass does not warrant protective measures that would deny them angling opportunities on migrant fish. However, it would be a denial of DFO responsibility to further deplete native stocks so as to be able to catch the increasingly abundant U.S.-origin fish that are available as a result of the massive

restoration and management program begun in 1981 (ASMFC 1989).

Artificial Restoration

Stocking of juvenile striped bass in the Saint John and Annapolis rivers may well be the only option if rehabilitation of the severely depressed/extinct native stocks is to occur. Prompt action (within one or two years) is necessary to ensure obtaining native stock adults or eggs from the Annapolis River. Collection of eggs or native-origin broodstock from the Saint John River may prove impossible, in which case the merit of introducing juvenile striped bass of Shubenacadie River origin must be decided. Where environmental conditions prevent successful striped bass spawning, failure to correct these conditions prior to, or in conjunction with, rehabilitative stocking would create a continuing requirement for stocking, i.e., a put-and-take situation. The source of broodstock for rehabilitation programs must meet the guidelines of the "Introductions and Transfer Policy" (R. E. Cutting, Chair, Introductions and Transfer Committee, Department of Fisheries and Oceans, Halifax; pers. comm.). The Shubenacadie River striped bass stock is likely the most suitable in terms of genetic and disease acceptability for introduction into other Bay of Fundy rivers. Shubenacadie River striped bass are genetically distinct from those of Gulf of St. Lawrence rivers, e.g., Miramichi River (Wirgin et al. 1993). The possibility of capturing non-spawning migrant striped bass during the spawning run of native striped bass in the Shubenacadie River (Wirgin et al. In press) might require genetic classification of individual fish before their acceptance for broodstock purposes. Monitoring changes in the stock composition resulting from a rehabilitation program may require improved knowledge of the origin of U.S. migrant fish (Waldman and Fabrizio 1994).

The success of the U.S. striped bass fishery management plan indicates that severe restriction of exploitation coupled with a multimillion dollar program of rehabilitative fish stocking can restore striped bass stocks to desired levels of abundance where environmental conditions permit. Thus, as one part of this program, the Maryland Department of Natural Resources stocked about 300,000 fingerlings annually during the late 1980s (ASMFC 1990). The management plan was, amongst other actions, to continue the stocking program for 9 years, to allow maturation and return of adult females from three year-classes prior to reopening fisheries, and to terminate stocking if restoration was successful, as indicated by acceptable juvenile indices for 3 years, or if marked stocked fish fail to return as brood fish or those brood fish produce no progeny due to habitat conditions (ASMFC 1990). Similar criteria for evaluating the success of a rehabilitation program might be considered for use in Scotia-Fundy Region. The cost and production logistics of large scale stocking of striped bass in the Bay of Fundy area may prove prohibitive; the present fiscal situation may militate against this option. A small scale stocking program may prove unsuccessful in achieving restoration/rehabilitation goals.

In summary, the existence and future abundance of striped bass native to rivers in the Bay of Fundy area depend on the choices that must soon be made for managing these stocks.

Acknowledgements

I thank L. Marshall and R. E. Cutting for constructive comments on drafts of this report.

References

Adams, A. L. 1873. Field and forest rambles with notes and observations on the natural history of eastern Canada. H. S. King and Co., London.

Atlantic States Marine Fisheries Commission. 1989. Supplement to the striped bass FMP - Amendment #4. Fish. Mgmt Rep. No. 15. 60 p.

Atlantic States Marine Fisheries Commission. 1990. Source document for the supplement to the striped bass FMP - Amendment #4. Fish. Mgmt Rep. No. 16.

Daborn, G. R., J. T. O'Neill, and R. R. G. Williams. 1979. Limnology of the Annapolis River and estuary II. Fish distributions in the estuary, 1976 and 1977. Proc. N.S. Ins. Sci. 29: 173-183.

Dadswell, M. J. 1976. Notes on the biology and research potential of striped bass in the Saint John estuary. In Baseline survey and living resource potential study of the Saint John River estuary. Vol. 3, Fish and Fisheries. Huntsman Marine Lab., St. Andrews, N.B. 106 p.

Fisheries and Oceans. 1992. A management strategy for striped bass in New Brunswick. Discussion Document. 7 p.

Fisheries and Oceans. 1994. Striped bass management plan for 1994 announced. NR-SF-94-13E. 3 p.

Harris, P. J., and R. A. Rulifson. 1988. Studies of the Annapolis River striped bass sport fishery, 1987. I. Creel survey. Inst. for Coastal and Marine Resources, East Carolina Univ., Report to Tidal Power Corp., Halifax, Nova Scotia. (ICMR Tech. Rep. 88-03). 30 p.

Jessop, B. M. 1976. Physical and biological survey of the Annapolis River, 1975. Dept. Envir., Fish. Mar. Serv., Res. Br. Data Record Ser. No. MAR/D-76-8.

Jessop, B. M. 1980. Creel survey and biological study of the striped bass fishery of the Annapolis River, 1978. Can. Man. Rep. Fish. Aquat. Sci. No. 1566. 20 p.

Jessop, B. M. 1983. Aspects of the life history of the Atlantic silverside (Menidia menidia) of the Annapolis River, Nova Scotia. Can. Man. Rep. Fish. Aquat. Sci. No. 1694. 41 p.

Jessop, B. M. 1990. The status of striped bass in Scotia-Fundy Region. Can. Atl. Fish. Sci. Advis. Comm., Res. Doc. 90/36. 22 p.

Parker, W. R., and K. G. Doe. 1981. Studies on the reproduction of striped bass Morone saxatilis (Walbaum) from the Annapolis River, Nova Scotia. Envir. Prot. Serv. EPS-5-AR-81-6. 89p.

Setzler-Hamilton, E. M., and L. Hall, Jr. 1991. Striped bass Morone saxatilis. pp. 13-1 -13-31. In Funderburk, S. L., J. A. Mihursky, S. J. Jordan, and D. Riley (Eds.) Habitat requirements for Chesapeake Bay living resources, 2nd Edition. Living Resources Subcomm., Chesapeake Bay Progr. Annapolis, MD.

Waldman, J. R., and M. C. Fabrizio. 1994. Problems of stock definition in estimating relative contributions of Atlantic striped bass to the coastal fishery. Trans. Amer. Fish. Soc. 123: 766-778.

Wiles, M. 1979. Successful rearing of striped bass, Morone saxatilis (Walbaum), from fertilized eggs in small aquaria, with reference to environment, feeding and growth, and bacterial disease. Biology Department, Saint Mary's Univ., Halifax.

Williams, R. R. G., G. R. Daborn, and B. M. Jessop. 1984. Spawning of the striped bass (Morone saxatilis) in the Annapolis River, Nova Scotia. Proc. N. S. Inst. Sci. 34: 15-23.

Wirgin, I. I., T.-L. Ong, L. Maceda, J. R. Waldman, D. Moore, and S. Courtenay. 1993. Mitochondrial DNA variation in striped bass (Morone saxatilis) from Canadian rivers. Can. J. Fish. Aquat. Sci. 50: 80-87.

Wirgin, I. I., B. M. Jessop, S. Courtenay, M. Pedersen, S. Maceda, and J. R. Waldman. in press. Mixed stock analysis of striped bass in two rivers of the Bay of Fundy as revealed by mitochondrial DNA. Can. J. Fish. Aquat. Sci. 51: 000-000.